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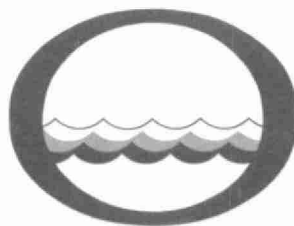


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SNOW WILMOT



Water Management in Ontario

SNOW SURVEY REPORT WILMOT CREEK BASIN 1966 - 67

PRELIMINARY DATA REPORT NO. 67-1
DIVISION OF WATER RESOURCES
RIVER BASIN RESEARCH BRANCH



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Rep. 201
SNOW SURVEY REPORT - WILMOT CREEK
BASIN - 1966/67 - PRELIMINARY DATA
No. 67-1 - D.S. PUCCINI, P.ENG.

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1967

Snow survey report - Wilmot
Creek basin, 1966-67 ;
preliminary data report no. 67-1
/ Puccini, D.S.

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SNOW SURVEY REPORT

WILMOT CREEK BASIN

1966-67

by

D. S. Puccini P. Eng.

Preliminary Data Report No. 67-1
River Basin Research Branch

K. E. Symons, Director
Division of Water Resources

Dr. J. A. Vance
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The Ontario Water Resources Commission

1967

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INTRODUCTION

To complete coverage of hydrologic conditions in the International Hydrological Decade research basins throughout the winter months, snow surveys were undertaken to obtain the following information:

- a) water equivalent of the snow pack
- b) depth of the snow pack
- c) areal extent of the snow pack.

Background reading revealed that most snow surveys in Canada and the United States had been carried out as an aid to predicting spring runoff and had been conducted on large drainage basins of up to thousands of square miles in extent with one snow course representative of a very large area.

The principles of site selection for smaller research basins are the same but a higher degree of accuracy is required and it is essential that a sufficient number of snow courses be located within the basin to ensure complete coverage. References indicate that, on the average, one snow course for every two to three square miles gives representative data.

Of the five representative basins under investigation, the Bowmanville, Soper and Wilmot creeks basin was selected for first attention since instrumentation for collection of other hydrometric data was most advanced there. The three basins are relatively similar in their topographic and climatic conditions so it was assumed that surveys would be necessary in one of them only. Because of the possibility that a portion of Wilmot Creek may serve as an experimental basin at some time in the future, the first snow courses were located there.

Some of the characteristics of a good snow course are as follows:

1. sheltered
2. flat
3. well-drained
4. free of stumps and debris
5. on clean litter, soil, or natural grass
6. readily accessible
7. not on cultivated fields

According to the U. S. Army Corps of Engineers, an ideal site is "an opening in the forest surrounded by hills for protection from high winds, and sloped sufficiently to permit run-off of water beneath the snowpack."

PROCEDURE

In the fall of 1966, field investigations were carried out to locate snow courses in the Wilmot Creek basin. To facilitate accessibility in times of heavy snowfall all of the snow courses were established as close as possible to good roads. At the outset, approximately twenty-five were selected and these were gradually narrowed down to the best twelve, giving a coverage of about one snow course for every two and half square miles in the basin. A preliminary map showing the basin and course locations is presented on page 14. Location data and comments on courses are given on pages 15 to 26.

Each snow course consisted of ten sampling points spaced at one-hundred foot intervals running in a straight line where possible. Due to local conditions it was sometimes necessary to vary the length of the course or the distance between

sampling points. Where it was not possible to run nine hundred feet continuously, L - shaped or discontinuous courses were laid out.

Each snow course was laid out to represent as closely as possible the surrounding countryside. For example, in heavily forested areas such as are found in the northern portion of the basin, snow courses were located between thick stands of trees to simulate the actual snowfall on the ground at these forested areas.

A Mount Rose Snow Sampler was obtained from the Meteorological Branch, Department of Transport. This instrument is best utilized where snow depths exceed two to three feet due to the small diameter tube. In southern Ontario, where snowfalls are usually somewhat less than this, a larger diameter tube is recommended. However, if great care is taken, satisfactory results can be obtained with the Mount Rose Sampler in depths greater than two inches.

The Mount Rose sampler is used to determine the water equivalent of a snowpack by taking several cores of known cross-section and determining the weight of each. This cross-section of 1.485 inches diameter is such that one inch of water equivalent of the snowpack weighs one ounce.

Snow surveying started in the basin when the snow depth exceeded two inches. This occurred early in January, 1967, with southern Ontario experiencing a later winter than usual. Surveys were conducted twice a month, on the average, until the final disappearance of snow from the ground. Each survey took two to three days to sample all twelve snow courses.

A summary of the results from the twelve courses is shown on pages 6, 7 and 8. These data represent the average of ten sampling points for each snow course. The sample snow survey report sheet on page 5 illustrates how the water equivalent is calculated. Snow depths on December 21, 1966, and January 6, 1967, were determined by measuring each snow course with a ruler to the nearest half-inch. Snow depths and water equivalents measured on January 10, 1967, through March 9, 1967, were determined by means of the Mount Rose Sampler and were measured to the nearest tenth of an inch.

RIVER BASIN RESEARCH BRANCH

SNOW SURVEY REPORT

Basin: Wilmot Creek Station: WSC-7Date: Jan. 10, 1967 Time: 11:30 AM-12:20 PM Temp: 30°FObserver: D. Puccini, D. Donohue

1. Sample Number	2. Snow Depth inches	3. Length of Core inches	4. Weight of tube ozs	5. Weight of tube & snow ozs	6. Water Equivalent inches	7. Comments
1	10.0	5.2	23.8	24.7	0.9	Snowing
2	10.0	4.6	23.8	24.7	0.9	
3	9.1	5.3	23.8	25.0	1.2	
4	9.5	4.7	23.8	24.6	0.8	
5	9.2	6.2	23.8	25.0	1.2	12:00 noon
6	11.0	5.5	23.8	24.9	1.1	snow stopped
7	8.6	4.8	23.8	24.9	1.1	
8	9.0	5.9	23.8	25.0	1.2	turn N.NE. direction toward post
9	9.3	5.4	23.8	24.7	0.9	
10	8.5	5.4	23.8	24.8	1.0	
Totals	94.2	53.0	238.0	248.3	10.3	
MEAN	9.4	5.3	23.8	24.8	1.0	

Crust: $\frac{1}{2}$ " Soil Conditions: Dry Ice Layers: Nil

COMMENTS: Snowing heavily. Depth $7\frac{1}{4}$ " - 12" First point is
10' North of Second F.P. on E.W. fence along
Taunton Rd. 2" fresh snow, crust $\frac{1}{2}$ "

RESULTS

<u>SNOW COURSE NUMBER</u>	<u>DATE</u>	<u>SNOW DEPTH (inches)</u>	<u>WATER EQUIVALENT (inches)</u>
WSC-1	Dec. 21/66	2	-
	Jan. 6/67	2	-
	Jan. 12	5.8	0.9
	Jan. 24	0	-
	Feb. 7	6.6	1.3
	Feb. 22	4.6	1.6
	Mar. 8	1	-
WSC-2	Dec. 21/66	0.5	-
	Jan. 6/67	2	-
	Jan. 12	7.8	1.4
	Jan. 24	1	-
	Feb. 7	6.4	1.4
	Feb. 24	1	-
	Mar. 9	4.4	1.7
WSC-3	Dec. 21/66	0.5	-
	Jan. 6/67	2	-
	Jan. 11	8.2	1.4
	Jan. 24	2	-
	Feb. 7	8.8	2.0
	Feb. 24	4.9	1.8
	Mar. 9	7.0	2.5
WSC-4	Dec. 21/66	0.5	-
	Jan. 6/67	2	-
	Jan. 11	6.9	1.0
	Jan. 24	2	-
	Feb. 7	6.8	1.3
	Feb. 22	6.5	1.5
	Mar. 9	7.5	2.4
WSC-5	Dec. 21/66	0.5	-
	Jan. 6/67	2	-
	Jan. 11	8.0	0.8
	Jan. 24	2	-
	Feb. 7	8.5	1.5
	Feb. 22	6.1	0.6
	Mar. 9	2	-

<u>SNOW COURSE NUMBER</u>	<u>DATE</u>	<u>SNOW DEPTH (inches)</u>	<u>WATER EQUIVALENT (inches)</u>
WSC-6	Dec. 21/66	0.5	-
	Jan. 6/67	2	-
	Jan. 11	10.5	1.3
	Jan. 24	2.5	-
	Feb. 8	10.0	1.4
	Feb. 22	8.3	1.1
	Mar. 9	11.0	3.2
WSC-7	Dec. 21/66	0.5	-
	Jan. 6/67	2	-
	Jan. 10	9.4	1.0
	Jan. 24	3.2	1.2
	Feb. 7	7.8	1.8
	Feb. 23	8.7	1.6
	Mar. 8	8.1	1.5
WSC-8	Dec. 21/66	0.5	-
	Jan. 6/67	2	-
	Jan. 10	8.6	0.5
	Jan. 24	2	-
	Feb. 8	-	-
	Feb. 24	5.8	2.0
	Mar. 8	-	-
WSC-9	Dec. 21/66	0.5	-
	Jan. 6/67	2	-
	Jan. 10	9.0	0.8
	Jan. 24	4.2	1.4
	Feb. 8	6.4	1.4
	Feb. 23	8.3	1.3
	Mar. 8	8.6	2.2
WSC-10	Dec. 21/66	0.5	-
	Jan. 6/67	2	-
	Jan. 10	9.3	0.9
	Jan. 24	2.5	-
	Feb. 8	5.0	0.8
	Feb. 23	6.3	1.3
	Mar. 8	6.8	2.0

<u>SNOW COURSE NUMBER</u>	<u>DATE</u>	<u>SNOW DEPTH (inches)</u>	<u>WATER EQUIVALENT (inches)</u>
WSC-11	Dec. 21/66	0.5	-
	Jan. 6/67	2	-
	Jan. 10	11.8	1.1
	Jan. 24	5.3	1.3
	Feb. 8	9.8	1.9
	Feb. 23	10.9	2.0
	Mar. 8	10.9	2.3
WSC-12	Dec. 21/66	0.5	-
	Jan. 6/67	2	-
	Jan. 10	9.8	0.8
	Jan. 24	3.1	1.8
	Feb. 8	6.8	1.2
	Feb. 23	11.3	1.6
	Mar. 8	8.8	2.0

OTHER METHODS

There are three other methods that may be employed to determine water equivalent and density of snow. They are the nuclear density gauge, the pressure pillow, and other sampling instruments. Each of these is briefly discussed below.

1. Nuclear Density Gauge

This device is similar in principle to that of the soil moisture meter which is presently used by this branch. It consists of a two-probe density gauge which is used to measure the mass per unit volume of thin horizontal layers of material between parallel access tubes spaced twelve inches apart. The radioactive source is inserted into one tube and the detector into the other, to the same depth. Gamma photons are emitted from the source, detected by the probe, and the resultant pulse output is indicated on the scaler. The amount of water in the snow pack and the density are obtained at half-inch intervals.

The chief advantage of this method is the high degree of precision that can be obtained compared to the conventional Mount Rose Sampler.

Accessories can be obtained for the soil moisture meter available to the branch to permit its use as a snow density gauge.

2. Pressure Pillow

Pressure pillow gauges operate on the principle that the weight of a given amount of snow is a measure of the water content of the snow. These consist of a synthetic rubber pillow filled with an anti-freeze solution. A standpipe is connected from the interior of the pillow to a float-type recorder. Fluctuations in the liquid level in the pillow from changes in

snowcover are recorded and water content and density are determined from calibration curves.

The accuracy of this system is very high but the main disadvantages are the expense and intricacy of this type of snow measuring device. Also, it is more convenient in research basins to utilize portable equipment so that snowpack characteristics can be determined at any point in the basin.

3. Other Samplers

There are numerous other snow samplers in use, all of them supposed improvements on the original Mount Rose Sampler. They contain certain refinements on the cutting portion of the sampler in order that a completely undisturbed sample may be obtained. Generally, they have been developed to serve a specific purpose for local conditions and are not as widely used as the Mount Rose Sampler. Another technique which has been used to increase the accuracy of the sampling tube methods is to collect the sample in air-tight plastic bags for weighing in a laboratory. This eliminates the potential sources of error by field weighings.

DISCUSSION

The data that have been obtained from the 1966-67 snow survey of Wilmot Creek are expected to be very useful as an aid in the analysis and interpretation of the winter runoff cycle, which is especially important in this area due to the frequent freeze-thaw cycles which occur every winter.

Valuable experience in snow surveying site selection and technique was obtained. The limitations and sources of error in the sampling equipment were made more obvious after five or six complete snow surveys were carried out. For example, it was very difficult to weigh the snow cores accurately in the wind. Shallow snow depths on the course were not easily retained by the sampler. Also, frozen ground was almost impossible to penetrate when sampling, with the result that the core sometimes slipped out of the tube before weighing.

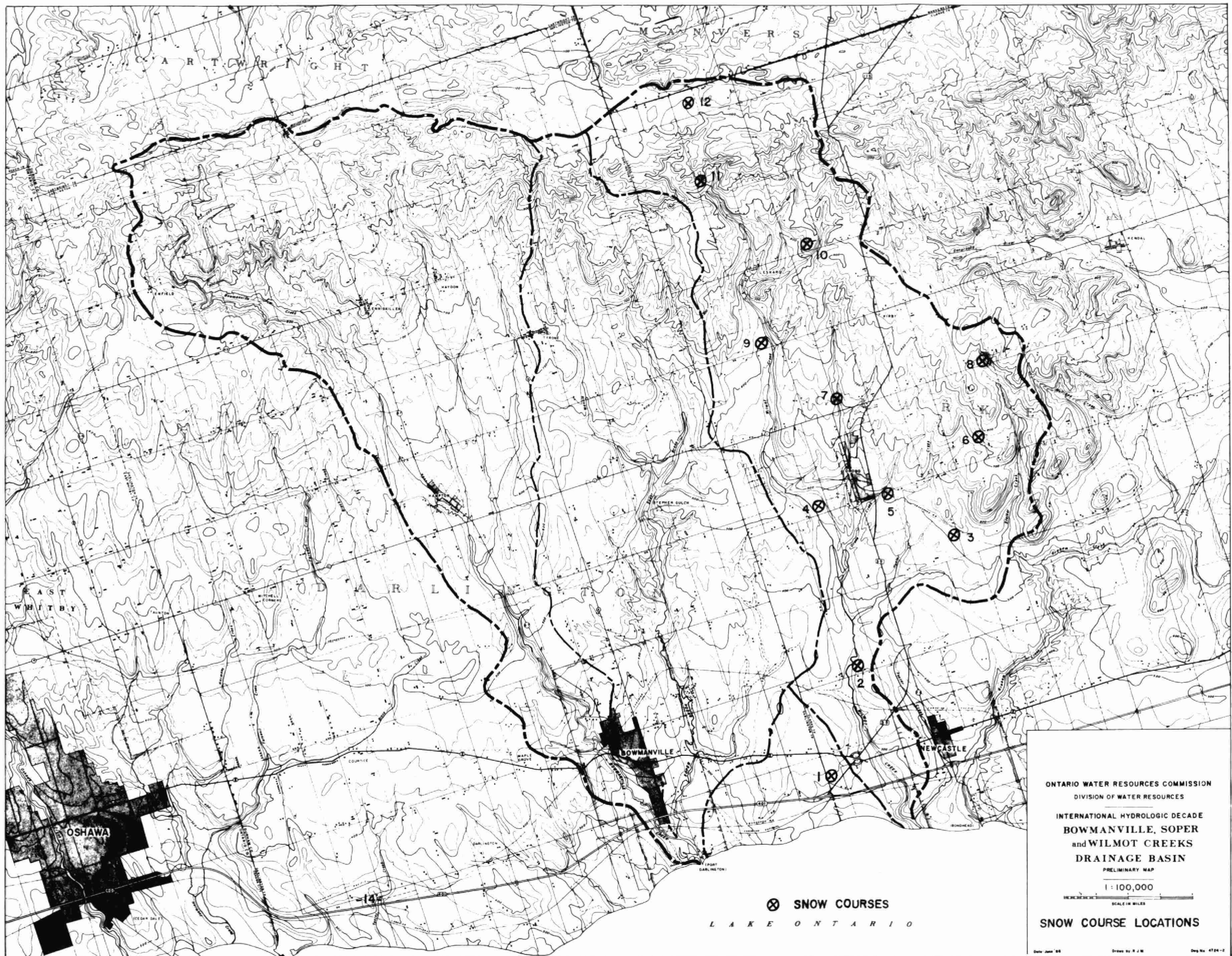
Present plans call for the location of snow courses in the remaining four representative basins for next winter. It is believed that a large number of snow courses and frequent surveys are required in each basin for the first year in order to determine the best snow courses. After one year the locations which give the most consistent and reliable data can be retained and sampled and the frequency adjusted.

RECOMMENDATIONS

It is recommended that snow courses be established in all research basins and that a nuclear density gauge be used to improve accuracy and reduce the number of sampling points.

REFERENCES

1. Handbook of Applied Hydrology - V. T. Chow
2. Introduction to Hydrometeorology - J.P. Bruce, R. H. Clark.
3. Department of Transport Publications:
 - "A Guide to Selection of Snow Survey Courses"
 - "The Mount Rose Snow Sampler"
 - "Instructions to Snow Surveyors"
4. Proceedings of the Eastern Snow Conference
1961, 62, 63, 64, 65, 66.



SNOW COURSE W-S-C-1

LOCATION

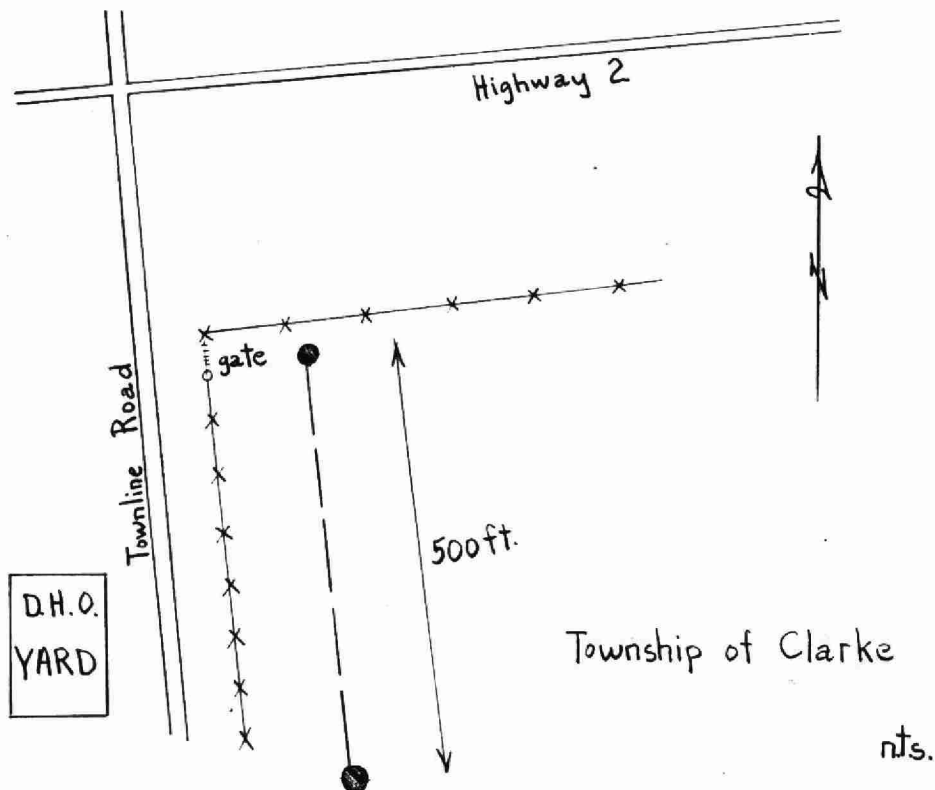


Fig. 1

COMMENTS

This snow course is located on the townline road between the townships of Darlington and Clarke about one-half mile south of Highway 2. It is representative of that portion of the Wilmot Creek basin situated between Highway 2 and Lake Ontario. The first sampling point is 20 ft. south of the EW fence and 10 ft. east of the NS fence. The course is 400 ft. long and consists of five sampling points 100 ft. apart.

SNOW COURSE W-S-C-2

LOCATION

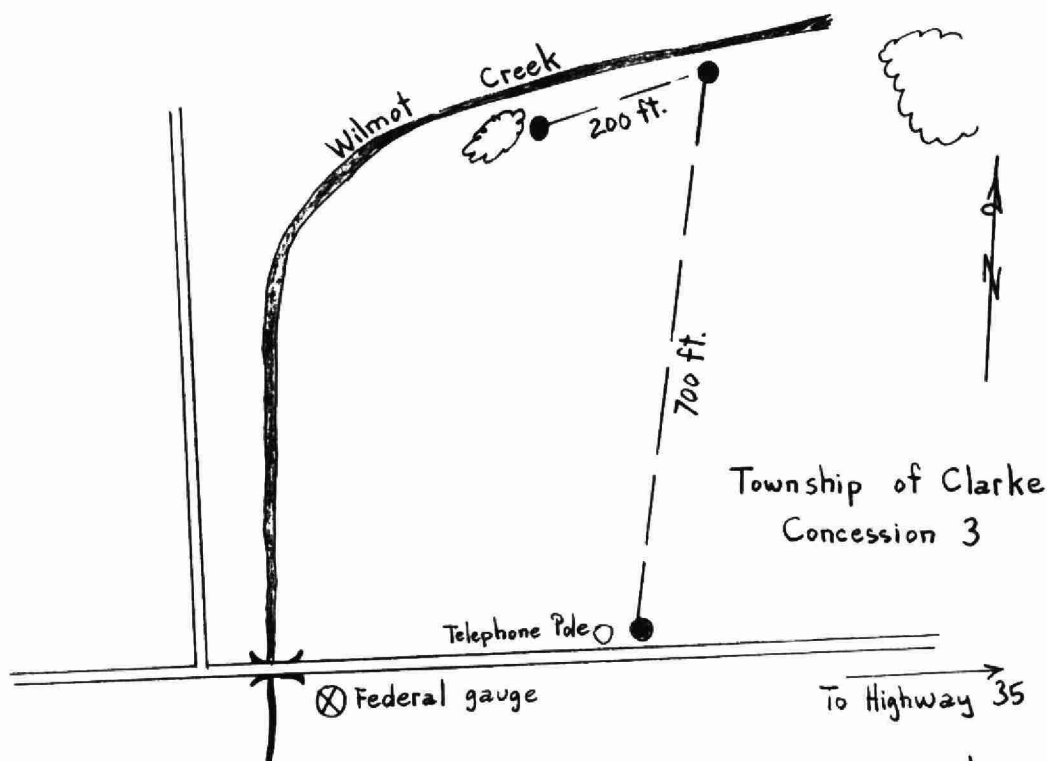


Fig. 2

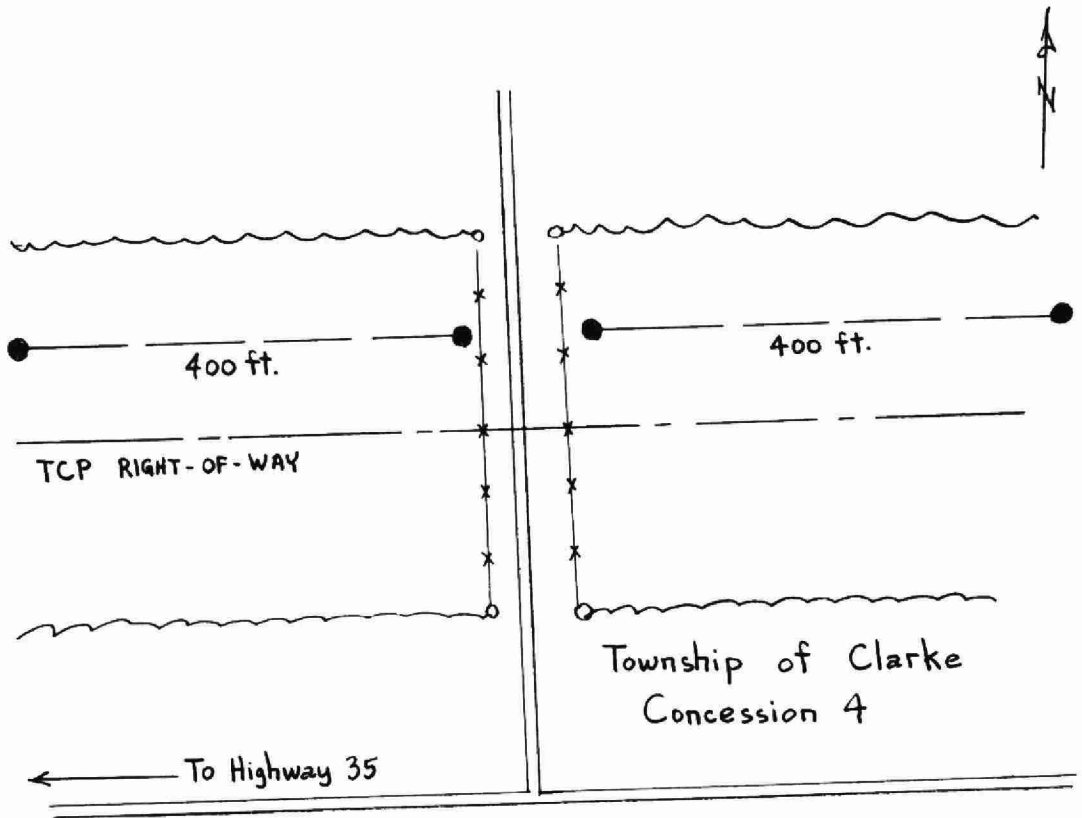
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COMMENTS

This snow course is located in the third concession of the Township of Clarke about one mile west of Highway 35 near the federal government streamflow gauging station on Wilmot Creek. It is representative of a mixed cover portion of the basin consisting of medium forest and open fields. The first sampling point is about 20 ft. north of the EW fence and the course runs 700 ft. to the creek, then 200 ft. in a southwesterly direction parallel to the creek towards a dogwood tree.

SNOW COURSE W-S-C-3

LOCATION



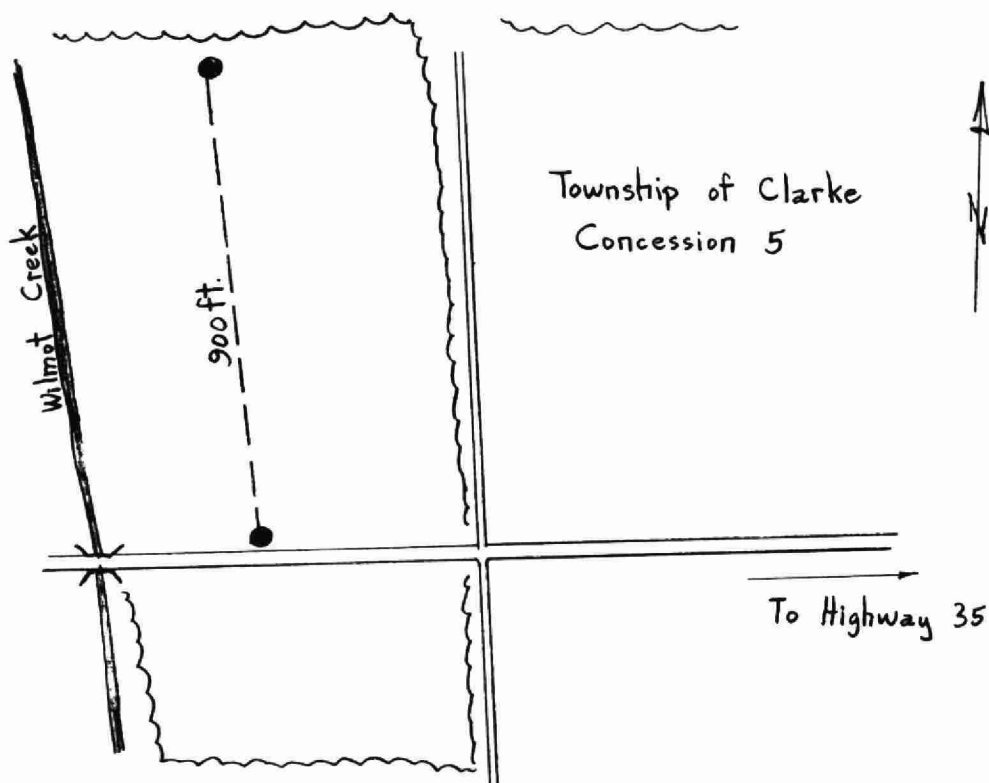
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Fig. 3

COMMENTS

This snow course is located on a Trans-Canada Pipeline right-of-way in the fourth concession of the Township of Clarke about one mile east of Highway 35. It is representative of a mixed cover portion of the basin consisting of medium forest and open fields. The first sampling point is 400 ft. east of the NS road and the last sampling point is 400 ft. west of the NS road. The snow course runs along the north half of the right-of-way between the forest and the pipeline.

LOCATION



nts.

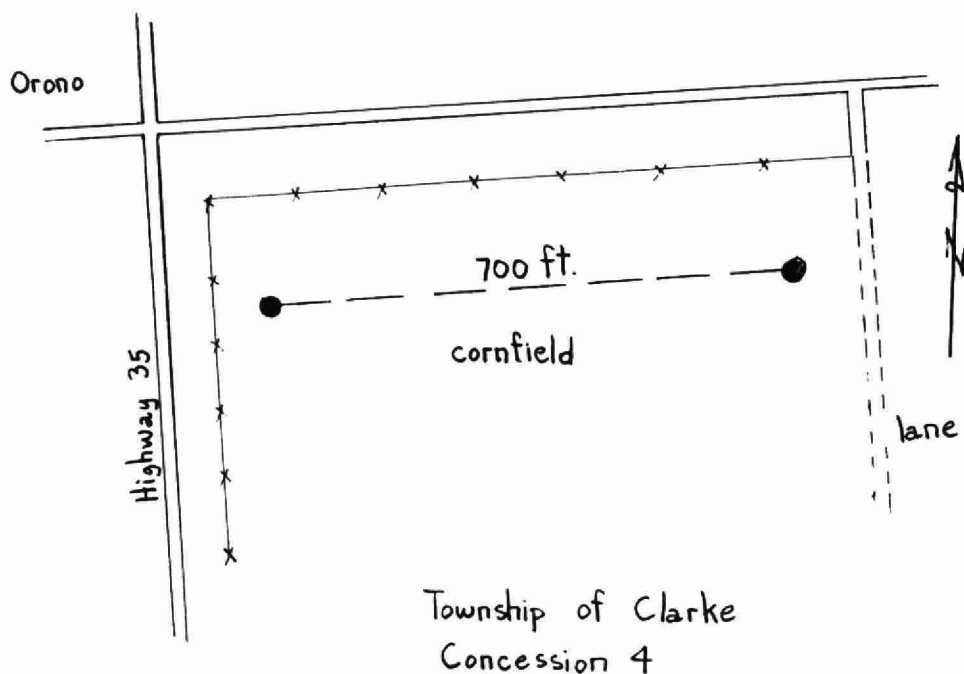
Fig. 4

COMMENTS

This snow course is located in the fifth concession of the Township of Clarke about ~~one~~ mile west of Orono. It is representative of a fairly heavily forested portion of the basin close to the main creek. The first sampling point is about 20 ft. north of the EW road and is situated between the creek to the west and a NS road to the east. There are 10 sampling points, 100 ft. apart running in a north-northwesterly direction.

SNOW COURSE W-S-C-5

LOCATION



n.t.s.

Fig. 5

COMMENTS

This snow course is located in the fourth concession of the Township of Clarke about one-half mile east of Highway 35 near Orono. It is representative of an open cover portion of the Wilmot Creek basin. The first sampling point is about 20 ft. east of the NS fence. The course runs parallel to the EW road between the fence and the cornfield. It consists of eight sampling points and is 700 ft. long.

SNOW COURSE W-S-C-6

LOCATION

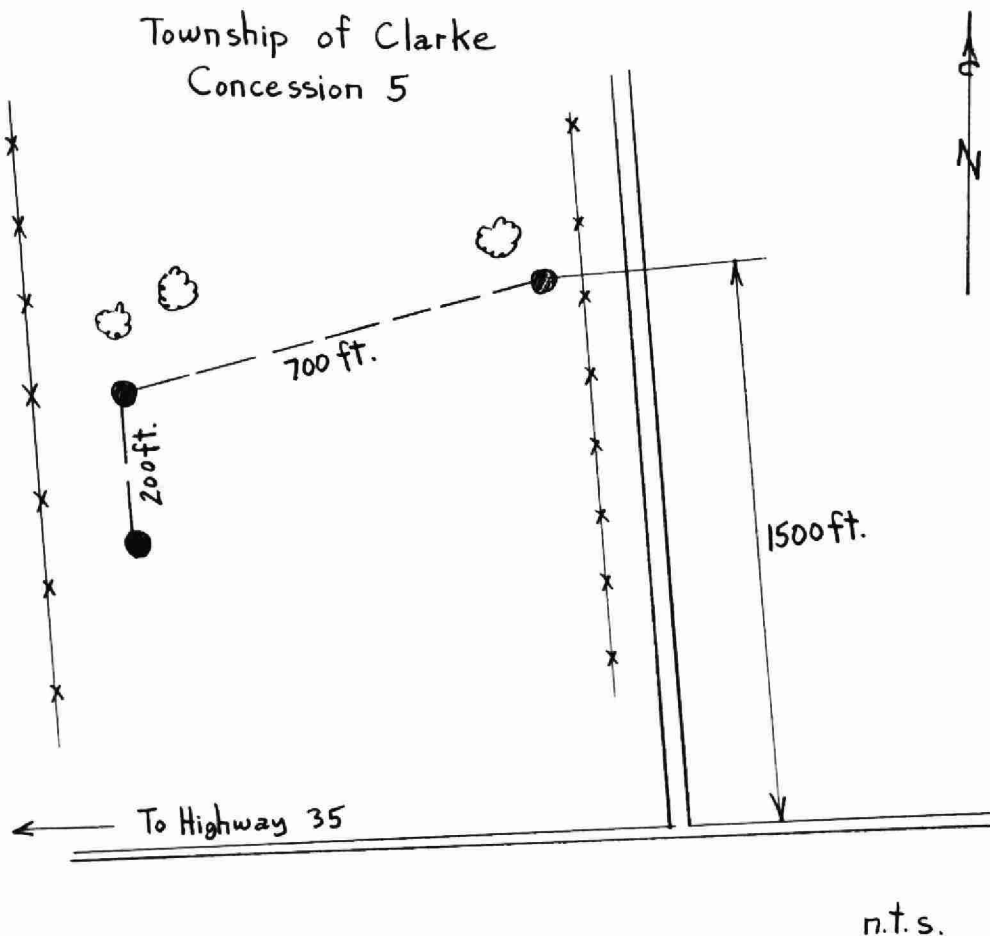


Fig. 6

COMMENTS

This snow course is located in the fifth concession of the Township of Clarke about one and a half miles east of Highway 35. It is representative of a mixed cover portion of the Wilmot Creek basin. The first sampling point is about 20 ft. west of the NS fence adjacent to a large evergreen tree. The course runs in a west-southwesterly direction 700 ft. towards a NS fence and then for 200 ft. south parallel to the fence. It consists of 10 sampling points 100 ft. apart.

SNOW COURSE W-S-C-7

LOCATION

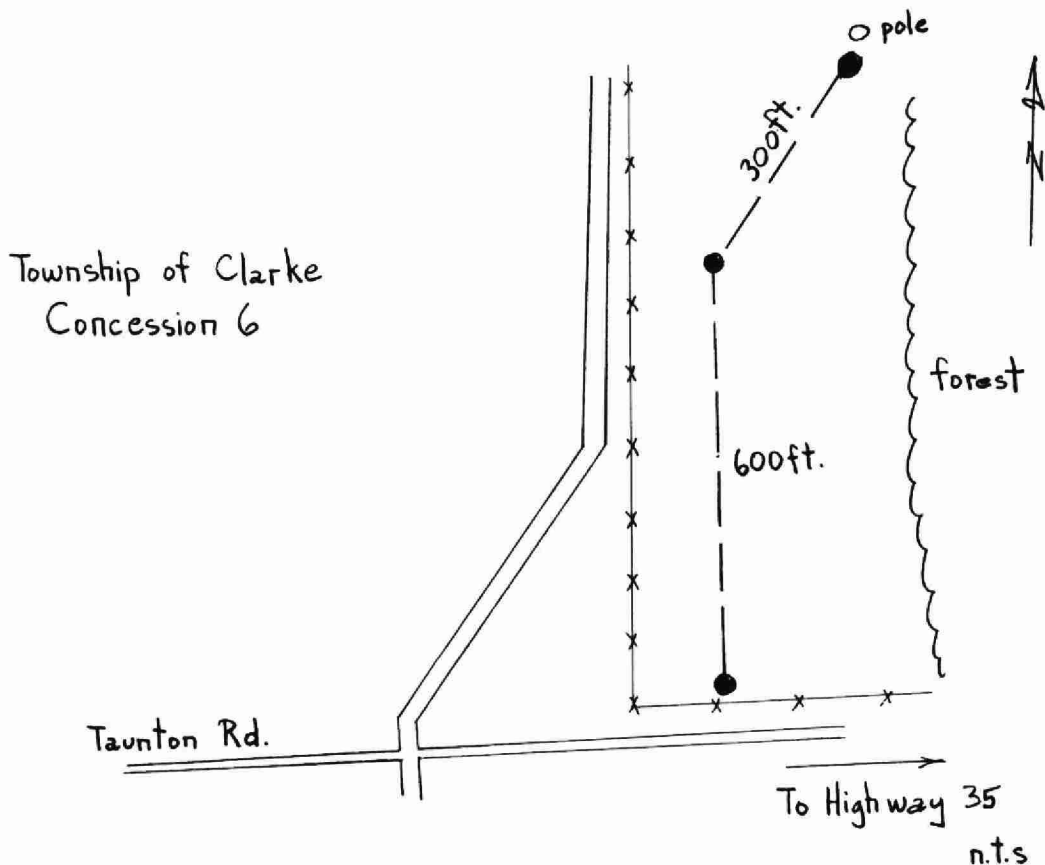


Fig. 7

COMMENTS

This snow course is located in the sixth concession of the Township of Clarke about one-half mile west of Highway 35 just above the Taunton Road. It is representative of a mixed cover portion in the central part of the Wilmot Creek basin. The first sampling point is 10 ft. north of the second fence post on the EW fence. There are ten sampling points each 100 ft. apart. The course is irregular as shown in the above sketch.

LOCATION

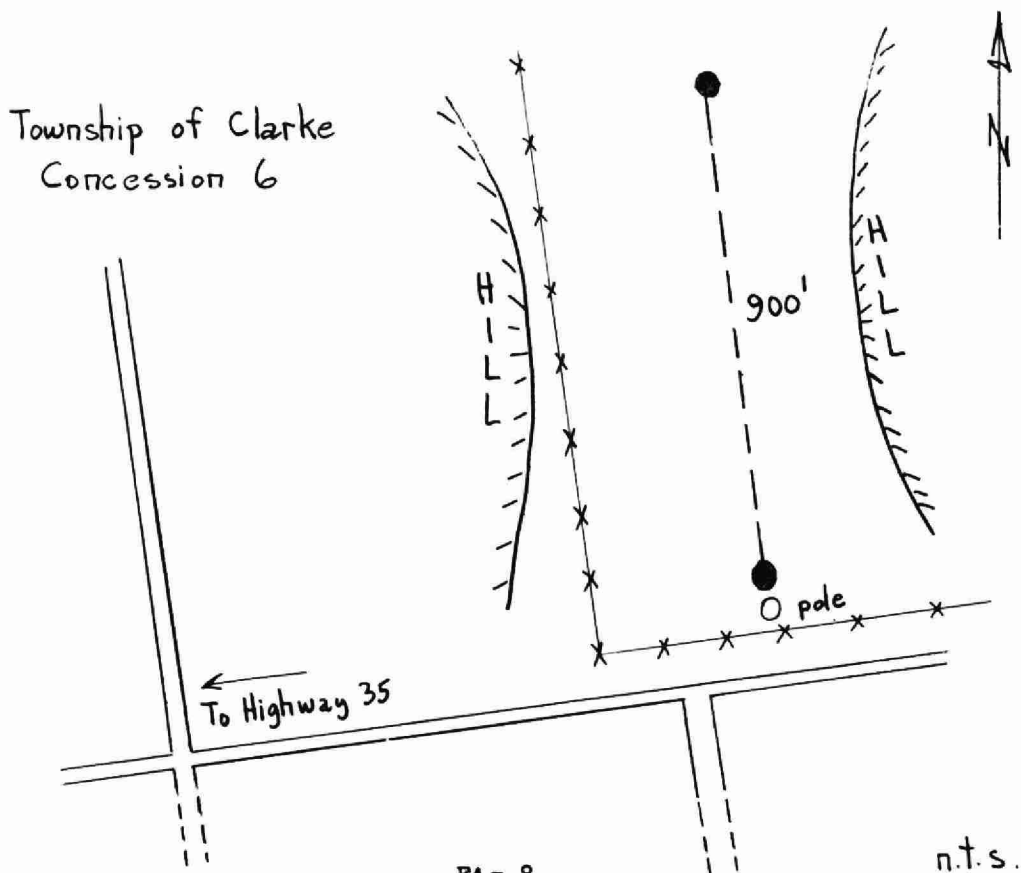


Fig. 8

COMMENTS

This snow course is located in the sixth concession of the Township of Clarke about two miles east of Highway 35 near the eastern boundary of the basin. It is representative of open cover with little or no protection typical of this part of the basin. The first sampling point is about 20 ft. north of the EW fence adjacent to a hydro pole east of the NS fence between two hills. There are ten sampling points each 100 ft. apart. The course is 900 ft. long.

SNOW COURSE W-S-C-9

LOCATION

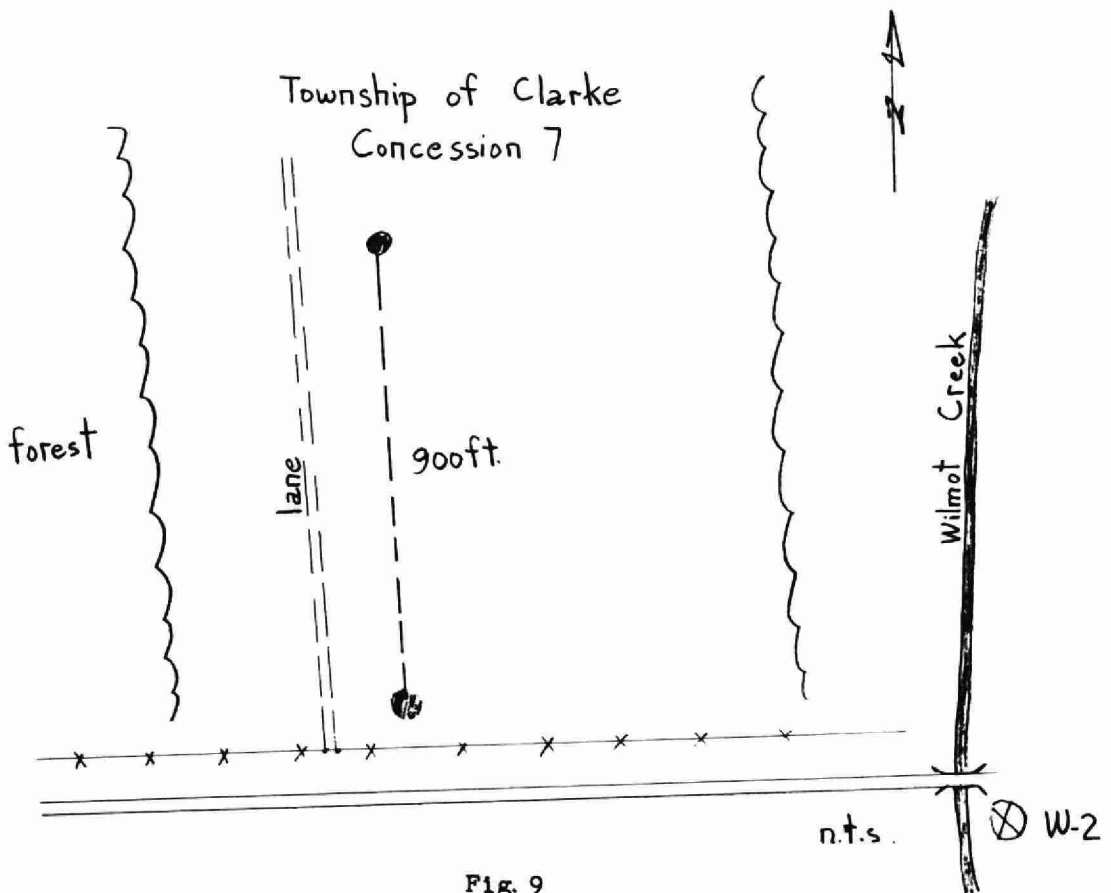


Fig. 9

COMMENTS

This snow course is located in the seventh concession of the Township of Clarke about 1500 ft. west of automatic streamflow gauging station W-2. It is representative of a forest cover portion of the Wilmot Creek basin. The first sampling point is about 20 ft. north of the EW fence and the course runs in a northwesterly direction just east of the lane running through the field. There are ten sampling points each 100 ft. apart. The course is 900 ft. long.

SNOW COURSE W-S-C-10

LOCATION

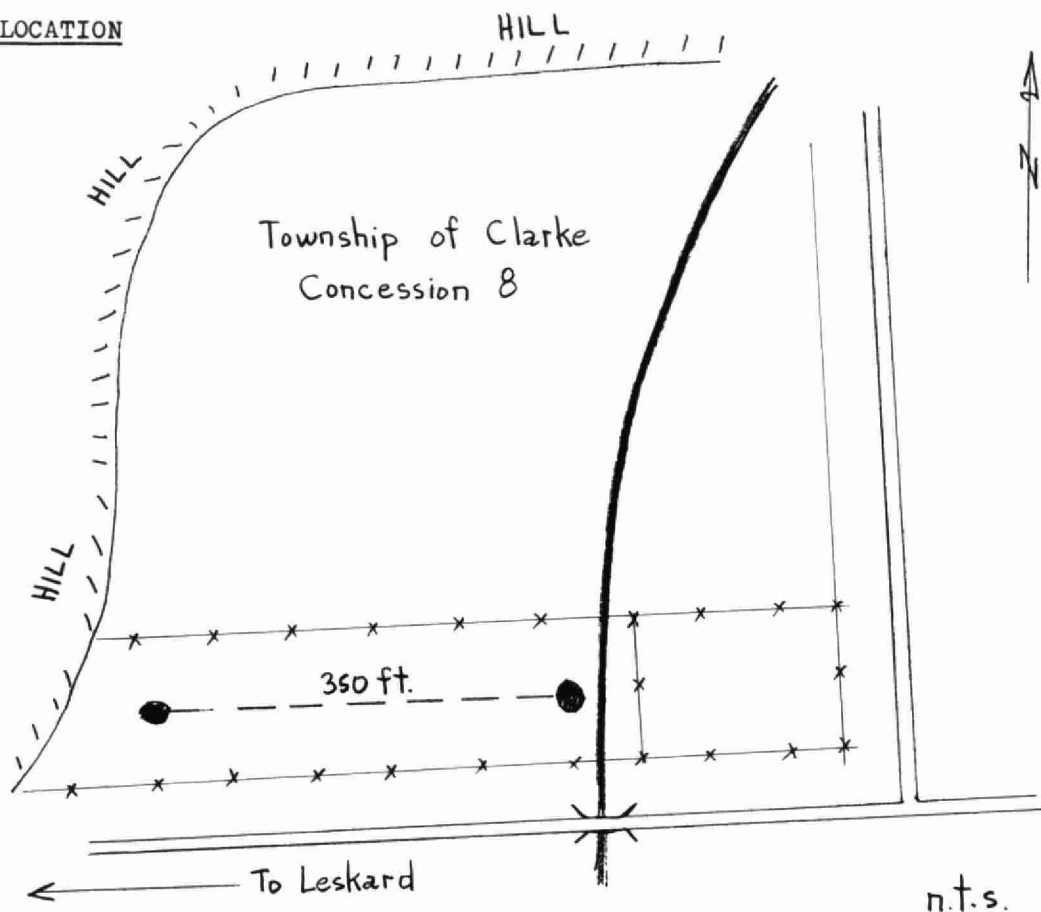


Fig. 10

COMMENTS

This snow course is located in the eighth concession of the Township of Clarke about one mile west of Highway 35 on the road to Leskard. It is representative of a mixed cover portion of the Wilmot Creek basin. The sampling points are located between the two fences on the north side of the road. The first point is about 20 ft. west of the creek. There are eight sampling points 50 ft. apart. The course is 350 ft. long.

SNOW COURSE W-S-C-11

LOCATION

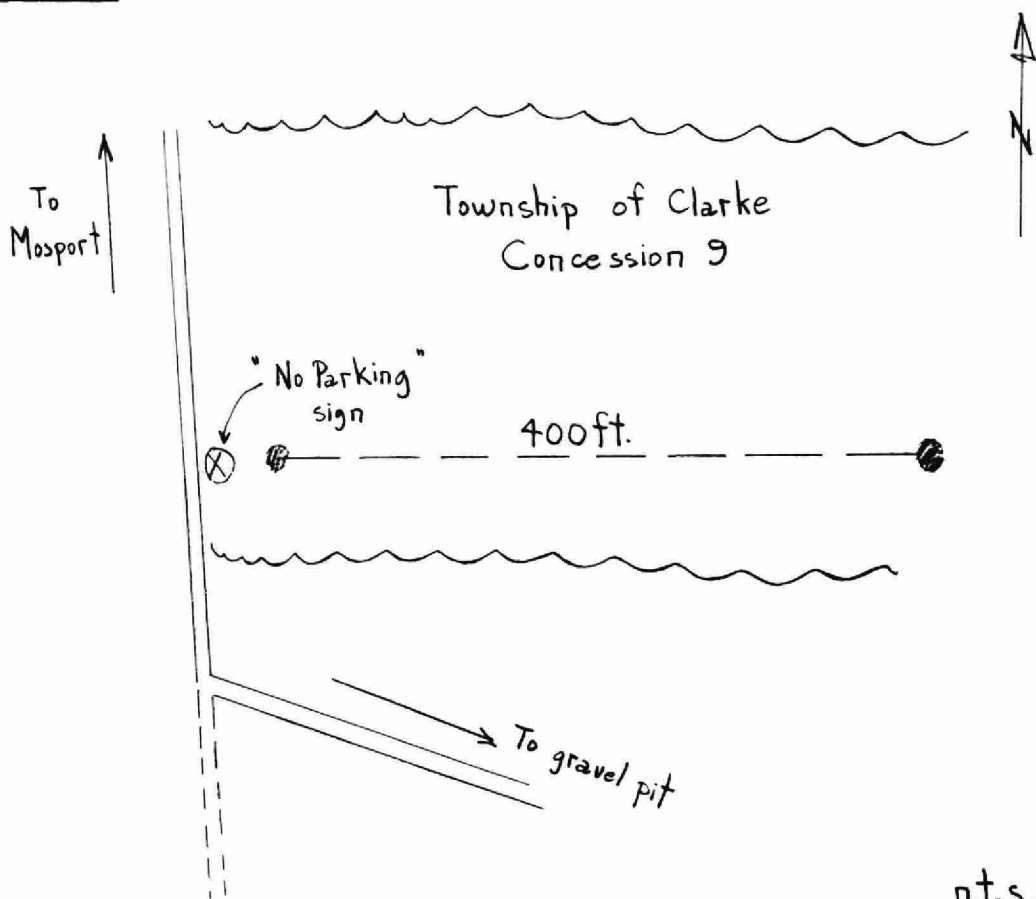


Fig. 11

COMMENTS

This snow course is located in the ninth concession of the Township of Clarke about one mile south of Mosport track. It is representative of a heavy forest cover portion of the Wilmot Creek basin. The first sampling point is about 25 ft. east of the "NO PARKING" sign on the NS road. There are five points spaced at 100-foot intervals for a total of 400 ft. The course runs parallel to the edge of the southerly tree line.

SNOW COURSE W-S-C-12

LOCATION

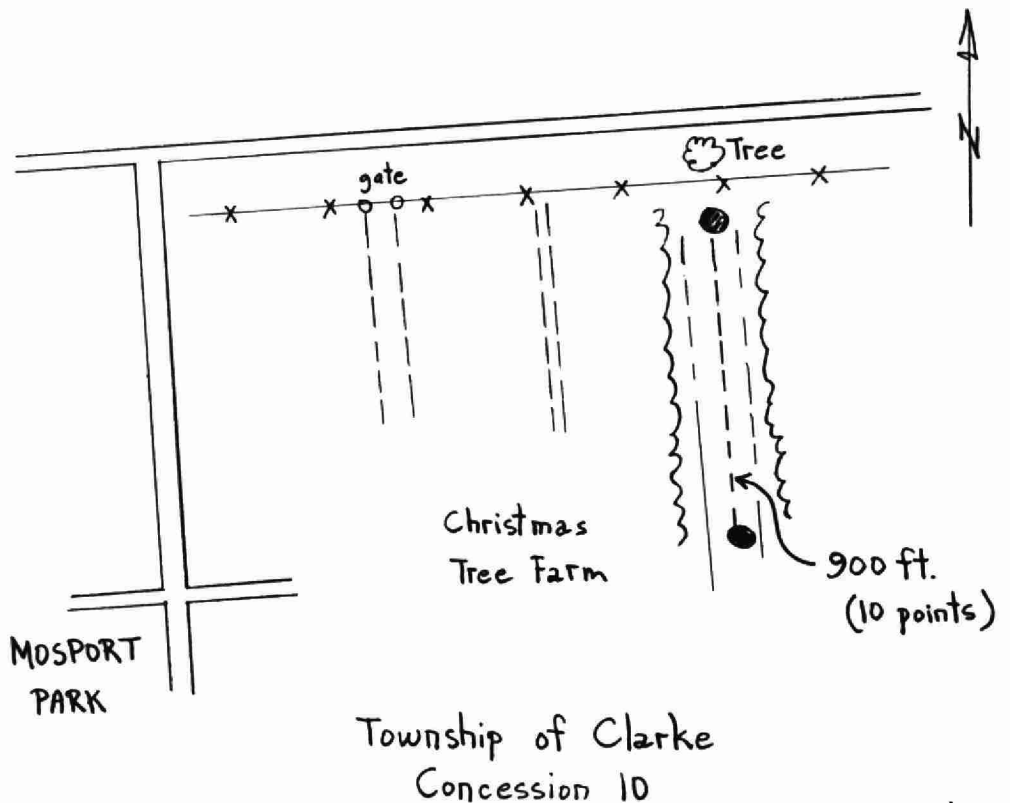


Fig. 12

n.t.s.

COMMENTS

This snow course is located in the tenth concession of the Township of Clarke about 3 miles west of Highway 35 and one-half mile north of Mosport track near the northern boundary of the Wilmot Creek basin. It is representative of a medium forest cover portion of this basin. The first sampling point is about 40 ft. south of a large tree on the EW fence line and the course runs in a southerly direction between the Christmas trees on the east half of the laneway. There are 10 sampling points spaced at 100-foot intervals.